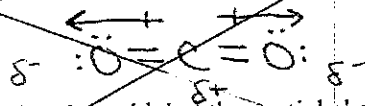


## LIVING BY CHEMISTRY

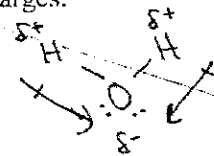
- 6) Why is  $\text{CO}_2$  nonpolar if it contains polar bonds? Draw the molecule to explain your answer.

Bonds between C and O are polar: O is more electronegative.  
But the dipoles cancel out by pulling in opposite directions

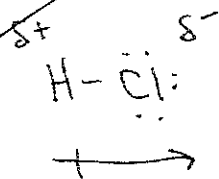


\* Remember: dipole points to more EN atom, which is  $\delta^-$

- 7) a) Draw a water molecule and label the partial charges.



- b) Draw HCl, the partial charges, and the dipole.



## WEATHER

### Unit 3, Section I

- 8) What is "weather" and what causes it? Winds, clouds, temp, and precipitation in a region at any given time  $\rightarrow$  Caused by physical changes to matter

- 9) Describe 3 pieces of information found on a weather map.

Temp, Warm and Cold fronts, Jet stream, high and low P, precipitation, clouds

- 10) What is a physical change?

Alters form but NOT the identity (chemical make-up) of substance

- 11) What does it mean if two variables have a directly proportional relationship?

Both increase (or decrease) at the same rate (ex. One doubles, other doubles)

- 12) Order rain, ice, and snow from least dense to most dense. What are their respective densities?

Least dense: Snow (0.1-0.5 g/mL), Ice (0.92 g/mL), Rain (1.0 g/mL)

- 13) Suppose that you melt 80 mL of ice. What is the volume of liquid water that results?

$$\begin{array}{l} \text{Ice: } V = 80 \text{ mL} \\ d = 0.92 \text{ g/mL} \\ m = ? \end{array} \quad \begin{array}{l} m = (0.92 \frac{\text{g}}{\text{mL}})(80 \text{ mL}) \\ = 73.6 \text{ g ice} \end{array} \quad \left\{ \begin{array}{l} 73.6 \text{ g ice melts to } 73.6 \text{ g liquid} \\ V = ? \quad d = 1 \text{ g/mL} \\ m = 73.6 \end{array} \right. \quad V = \frac{73.6 \text{ g}}{1 \text{ g/mL}} = \boxed{73.6 \text{ mL}}$$

- 14) Suppose that have a box with a volume of 22.5 mL. If you fill this box with ice, what mass of ice do you have?

$$\begin{array}{l} V = 22.5 \text{ mL} \\ d = 0.92 \text{ g/mL} \end{array} \quad \begin{array}{l} m = d \times V \\ = 0.92 \frac{\text{g}}{\text{mL}} \times 22.5 \text{ mL} = \boxed{20.7 \text{ g}} \end{array}$$

- 15) What is the difference between a boiling point and a melting point? What are these values for water?

Temps at which a substance boils or melts, respectively.

B.P. Water =  $100^\circ\text{C}$

M.P. Water =  $0^\circ\text{C}$



# LIVING BY CHEMISTRY

16) What is "absolute zero"?

Zero degrees on Kelvin scale; Theoretically lowest temperature possible  
 $0\text{ K} = -273^{\circ}\text{C}$

17) Define temperature.

average amount Kinetic E in a sample

18) According to the kinetic theory of gases, describe how particles in a sample of gas move.

constant, random, straight-line motion; collide with each other and surrounding objects

19) Which gas variables does Charles's Law explain? What is the relationship between these variables?

"Charles watches Direct TV"  $\rightarrow$  Kelvin T and V are directly proportional

20) A 4.5 L gas sample at  $20^{\circ}\text{C}$  must be cooled to what temperature for the volume to change to 1.0 L?

$$V_1 = 4.5\text{ L}$$

$$T_1 = 20^{\circ}\text{C} + 273 = 293\text{ K}$$

$$T_2 = ?$$

$$V_2 = 1.0\text{ L}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow \frac{4.5\text{ L}}{293\text{ K}} = \frac{1.0\text{ L}}{T_2}$$

$$T_2 = 65.1\text{ K}$$

21) A man heats a balloon in the oven. If the balloon initially has a volume of 0.6 liters and a temperature of  $25^{\circ}\text{C}$ , what will the volume of the balloon be after he heats it to a temperature of  $225^{\circ}\text{C}$ ?

$$V_1 = 0.6\text{ L}$$

$$T_1 = 25^{\circ}\text{C} + 273 = 298\text{ K}$$

$$V_2 = ?$$

$$T_2 = 225^{\circ}\text{C} + 273 = 498\text{ K}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \frac{0.6\text{ L}}{298\text{ K}} = \frac{V_2}{498\text{ K}}$$

$$V_2 = 1.0\text{ L}$$

22) A soda bottle is flexible enough that the volume of the bottle can change even without opening it. If you have an empty soda bottle (volume of 2 L) at room temperature ( $25^{\circ}\text{C}$ ), what will the new volume be if you put it in your freezer ( $-4^{\circ}\text{C}$ )?

$$V_1 = 2\text{ L}$$

$$T_1 = 25^{\circ}\text{C} = 298\text{ K}$$

$$V_2 = ?$$

$$T_2 = -4^{\circ}\text{C} + 273 = 269\text{ K}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \frac{2\text{ L}}{298\text{ K}} = \frac{V_2}{269\text{ K}}$$

$$V_2 = 1.8\text{ L}$$

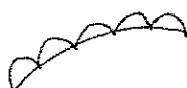
23) When does a cold front occur? How is it related to density?

cold air overtakes warm air; cold air is more dense so it pushes warm air up

24) A warm front is approaching your hometown and is due to arrive tomorrow. What kind of weather would you expect to observe? Which symbol on a weather map would show the front?

clouds and precipitation occur  $\rightarrow$  Warm fronts produce steady, light rain

$\rightarrow$  Cold fronts produce sudden, heavy rain

Warm front 

If  $T \uparrow, V \uparrow$

$T$  &  $V$   
are directly  
proportional

If  $T \downarrow, V \downarrow$

# LIVING BY CHEMISTRY

## Unit 3, Section II

25) Describe sublimation. What type of change is this?

Phase change from solid to gas  $\rightarrow$  Phase changes are physical changes

26) List the densities of gases, solids, and liquids from most dense to least dense.

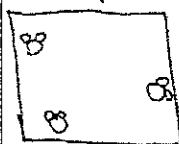
Most dense: Solids  $>$  liquids  $>$  gases

27) When water freezes, the water molecules move apart very slightly. What evidence can you provide to support this claim?

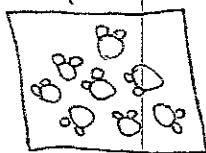
When they move apart, the volume increases so density decreases;  
Evidence of lower density is ice floating in water

28) Draw a molecular view for water vapor, liquid water, and ice.

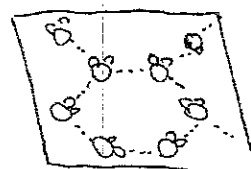
vapor



liquid



ice



29) What is the volume of 10.0 g  $\text{CO}_2(s)$ ? (The density is 1.56 g/mL)



$$V = \frac{m}{d} = \frac{10.0 \text{ g}}{1.56 \text{ g/mL}} = 6.4 \text{ mL}$$

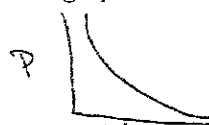
30) Explain what causes air pressure.

Caused by collisions between gas particles

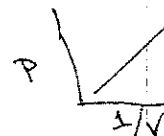
31) Which gas variables does Boyle's Law explain? What is the relationship between these variables? "Boyle is a VIP" Volume changes inversely with Pressure

\* More V  $\rightarrow$  less collisions  $\rightarrow$  Less P

32) Sketch a graph of P vs. V. Then sketch a graph of P vs. 1/V.

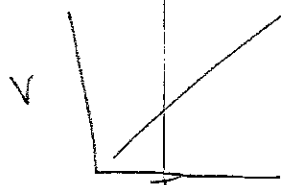


Inverse:



33) Which variables does Charles's law explain? What is the relationship between these variables?

See #19



Direct

34) If 1.00 L of a gas at standard temperature and pressure is compressed to 473 mL. What is the new pressure of the gas?

STP = standard temperature and pressure ( $0^\circ\text{C}$  and 1 atm)

$$V_1 = 1.00 \text{ L}$$

$$T_1 = 0^\circ\text{C} = 273 \text{ K}$$

$$P_1 = 1 \text{ atm}$$

$$V_2 = 473 \text{ mL}$$

$$P_2 = ?$$

$$P_1 V_1 = P_2 V_2$$

-OR-

$$\frac{P_1}{V_2} = \frac{P_2}{V_1}$$

$$(1 \text{ atm})(1 \text{ L}) = P_2(473 \text{ L})$$

$$P_2 = 2.1 \text{ atm}$$

# LIVING BY CHEMISTRY

- 35) Synthetic diamonds can be manufactured at pressures of  $6.00 \times 10^4$  atm. If we took 2.00 liters of gas at 1.00 atm and compressed it to a pressure of  $6.00 \times 10^4$  atm, what would the volume of that gas be?

$$P_1 = 1 \text{ atm}$$

$$V_1 = 2 \text{ L}$$

$$P_2 = 6 \times 10^4 \text{ atm}$$

$$P_1 V_1 = P_2 V_2$$

$$(1 \text{ atm})(2 \text{ L}) = (6 \times 10^4 \text{ atm}) V_2$$

$$V_2 = 3.33 \times 10^{-5} \text{ L}$$

- 36) Which gas variables does Gay-Lussac's Law explain? What is the relationship between these variables?

T (Kelvin) and P : Direct

\* Higher T  $\rightarrow$  Move Faster  $\rightarrow$  Collide More  $\rightarrow$  Higher P

- 37) A scuba-diving tank holds 21 L of air at a pressure of 38 atm. If the temperature does not change, what volume would this same air occupy if it were allowed to expand until it reached a pressure of 1.0 atm?

$$V_1 = 21 \text{ L}$$

$$P_1 V_1 = P_2 V_2$$

$$P_1 = 38 \text{ atm}$$

$$(38 \text{ atm})(21 \text{ L}) = (1 \text{ atm}) V_2$$

$$P \downarrow, V \uparrow$$

$$P_2 = 1 \text{ atm}$$

$$V_2 = 798 \text{ L}$$

$$V_2 = ?$$

- 38) Use the kinetic theory of gases to explain why decreasing the gas temperature decreases the gas pressure.

Lower T : Particles have less Kinetic E so they move more slowly. They collide less often so P decreases

- 39) How are areas of high and low pressure related to the weather?

High P : "good", clear, sunny weather

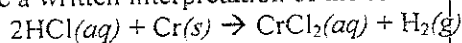
Low P : "bad", stormy weather

- 40) Which gas law contains variables that are inversely proportional? What does this mean?

Boyle's Law ( $V \propto P$ ) : When one variable changes, other does inversely  
ex If V doubles, P cut in half

## Unit 4, Section I

- 41) a) Write a written interpretation of the following chemical equation:



An aqueous solution of hydrochloric acid reacts with solid chromium to produce an aqueous solution of chromium(II) chloride and hydrogen gas

- b. What are the reactants and products? What do the symbols in parentheses mean? What is the difference between a subscript and a coefficient?

\* Reactants : HCl and Cr

\* Symbols in parentheses are phases

\* Products :  $\text{CrCl}_2$  and  $\text{H}_2$

\* Subscripts - # atoms

\* Coefficient - # molecules or moles

# LIVING BY CHEMISTRY

- 42) Toxic substances may be molecular, ionic, or metallic. Categorize the following compounds as ionic, molecular, or metallic:

a.  $\text{CH}_4\text{O}$       b.  $\text{Al}$       c.  $\text{Ca}(\text{OH})_2$       d.  $\text{Sn}$       e.  $\text{CaO}$   
 molecular      metallic      ionic      metallic      ionic  
 (all nonmetal)      (metal)      (metal + nonmetal)

- 43) Describe at least three types of effects that a toxic substance can have on the body.

Irritate tissue, upset acidity of blood, kidney stones, death

- 44) Write a chemical equation showing sodium chloride melting.



- 45) Write a balanced chemical equation for these reaction descriptions:

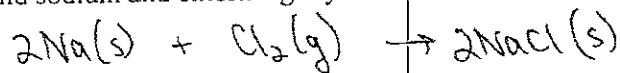
- a. Solid sodium chloride dissolves in water.



- b. Solid calcium sulfide is heated to produce solid calcium and sulfur gas.



- c. Solid sodium and chlorine gas yield solid sodium chloride.



- 46) The diatomic elements are:

$\text{H}_2, \text{N}_2, \text{O}_2, \text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2,$

- 47) What is the difference between a physical change and a chemical change?

Chemical change results in a new chemical substance(s)

- 48) Classify the following as physical or chemical changes:

a. Water freezes. P

d. Iron rusts. C

b. Methane burns. C

e. Carbon dioxide sublimates. P

c. Calcium chloride decomposes. C

f. A paper is folded. P

- 49) Classify the following as physical or chemical changes:

a.  $\text{NH}_4\text{Cl}(g) \rightarrow \text{NH}_4\text{Cl}(aq)$  P

b.  $2\text{CH}_3\text{O}(l) + \text{O}_2(g) \rightarrow 2\text{CH}_2\text{O}(l) + 2\text{H}_2\text{O}(l)$  C

c.  $\text{Hg}(l) \rightarrow \text{Hg}(g)$  P

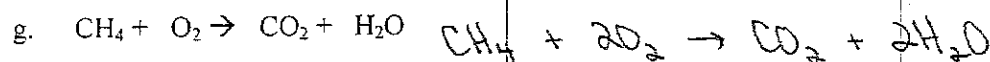
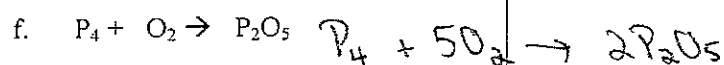
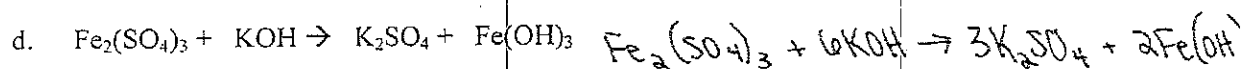
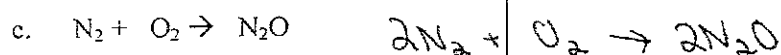
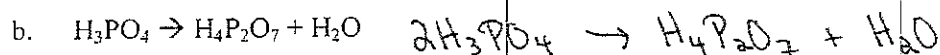
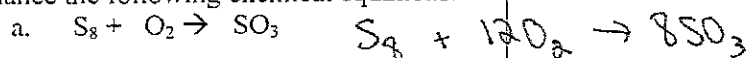
d.  $\text{CaO}(s) + \text{H}_2\text{O}(l) \rightarrow \text{Ca}(\text{OH})_2(s)$  C

# LIVING BY CHEMISTRY

50) Explain the law of conservation of mass.

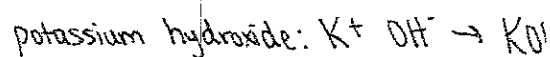
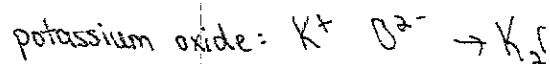
In a chemical or physical change, matter cannot be created nor destroyed.

51) Balance the following chemical equations:



52) Write and balance the following chemical equations:

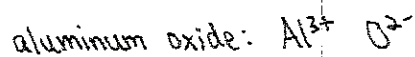
a. Potassium oxide + water  $\rightarrow$  potassium hydroxide



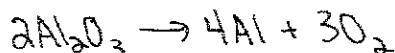
(Combination)



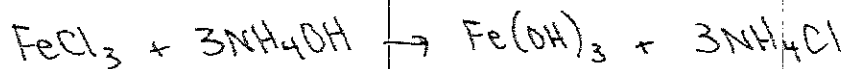
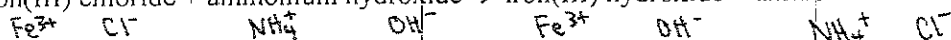
b. aluminum oxide  $\rightarrow$  aluminum + oxygen



(Decomp)

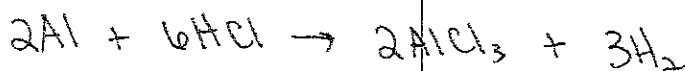


c. iron(III) chloride + ammonium hydroxide  $\rightarrow$  iron(III) hydroxide + ammonium chloride



(double exchange)

d. aluminum + hydrogen chloride  $\rightarrow$  aluminum chloride + hydrogen



(single exchange)

53) Classify the type of reaction for the equations in #51.

a) Combination

d) Double Exchange

g) Combustion

b) Decomposition

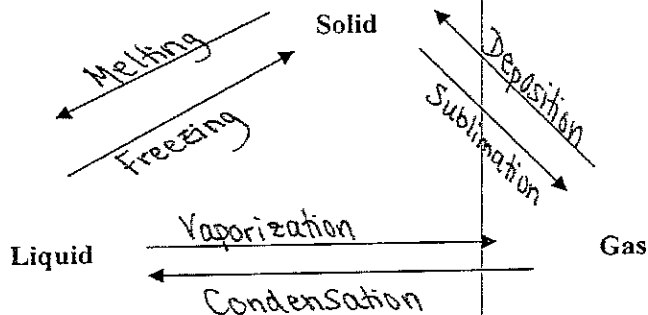
e) -

c) Combination

f) Comb.

## LIVING BY CHEMISTRY

54) List all of the phase changes between solids, liquids, and gases:



### Unit 4, Section II

55) What is "counting by weighing" and when is it useful?

Taking mass of a single object (or small group of them) and using it to determine # of large amount of small objects

$$\# = \frac{\text{total mass}}{\text{mass 1 item}}$$

56) A lentil has a mass of 0.056 g. A sample of lentils is measured to have a total mass of 400 g. How many lentils are in the sample?

$$\# = \frac{400 \text{ g}}{0.056 \text{ g}} = 7,142.9 \text{ lentils}$$

57) A lentil is measured on a balance to have a mass of 0.054 g. What is the % error in this measurement?

$$\% \text{ error} = \left| \frac{\text{observed value} - \text{actual value}}{\text{actual value}} \right| \times 100 \Rightarrow \left| \frac{0.054 \text{ g} - 0.056 \text{ g}}{0.056 \text{ g}} \right| \cdot 100 = 3.57\%$$

58) What is a mole?

Counting unit (like a dozen); A mole contains  $6.02 \times 10^{23}$  objects

59) Define molar mass.

The mass of 1 mole of a substance (Found on periodic table for elements)

60) Describe in words how to convert from mass to moles.

Mass (in grams) divided by molar mass (in grams/mol)

$$\text{g} \div \frac{\text{g}}{\text{mol}} = \text{mol}$$

61) Describe in words how to convert from moles to # of particles.

Multiply the number of moles by Avogadro's #

62) What is the molar mass of:

a. Ir

192.22 g/mol

b. Mn

54.94 g/mol

c.  $\text{Cu}_2\text{O}$

$63.55 \times 2$

+ 16.00

143.10 g/mol

d.  $(\text{NH}_4)_3\text{PO}_4$

$14.01 \times 3$

$1.01 \times 12$

30.97

+  $16.00 \times 4$

149.12 g/mol

# LIVING BY CHEMISTRY

63) a) I have 400 g of iridium. How many moles is this?

$$400 \text{ g} \div 192.22 \text{ g/mol} = \boxed{2.08 \text{ mol}}$$

Mass  $\div$  Molar Mass

b) How many atoms of Ir do I have?

$$(2.08 \text{ mol}) \times (6.02 \times 10^{23} \text{ atoms/mol}) = \boxed{1.25 \times 10^{24} \text{ atoms}}$$

Mol  $\times$  Avogadro's #

64) How many grams are in 2.65 moles of  $\text{Cu}_2\text{O}$ ?

$$2.65 \text{ mol} \times 143.10 \frac{\text{g}}{\text{mol}} = \boxed{379.22 \text{ g}}$$

Mol  $\times$  Molar Mass

65) A glass holds 50 g of  $\text{H}_2\text{O}$ . How many molecules are in the glass?

Mass  $\rightarrow$  Mol  $\rightarrow$  Molecules  
 $\div \text{MM} \quad \times 6.02 \times 10^{23}$

$$50 \text{ g} \div 18.02 \frac{\text{g}}{\text{mol}} \times (6.02 \times 10^{23} \text{ molecules/mol}) = \boxed{1.67 \times 10^{24} \text{ molecules}}$$

66) Which is more toxic: 1 mol of Hg or 10 g of Hg? Explain.

$$1 \text{ mol Hg} \times 200.59 \frac{\text{g}}{\text{mol}} = 200.59 \text{ g} > 10 \text{ g} \therefore \text{So one mole is more toxic.}$$

67) Which has more mass: 5 moles of  $\text{Cu}_2\text{O}$  or 10 moles of CuO?

$$5 \text{ mol Cu}_2\text{O} \times 143.10 \frac{\text{g}}{\text{mol}} = 715.5 \text{ g} \text{ vs. } 10 \text{ mol} \times 79.55 \frac{\text{g}}{\text{mol}} = 795.5 \text{ g}$$

## Unit 4, Section III

68) What is the difference between a homogeneous mixture and a heterogeneous mixture?

HOM: uniform throughout; solute and solvent evenly mixed

HET: not uniform throughout

69) What is a solution? What are the two parts of a solution?

Solution: Mixture of 2 or more substances that is uniform throughout

Solution: Contains solute and solvent

70) How do chemists express the concentration of a solution?

1) Molarity =  $\frac{\text{mol solute}}{\text{L solution}}$

2) ppm: parts per million

3) density =  $\frac{\text{mass}}{\text{volume}}$

other examples

71) Determine the molarity of the following solutions:

a. 5 mol NaCl in 5 L of solution:

$$M = \frac{5 \text{ mol}}{5 \text{ L}} = \boxed{1 \text{ M}}$$

b. 8 mol NaCl in 400 mL solution:

$$8 \text{ mol NaCl} \div 0.4 \text{ L} = 20 \text{ M}$$

$$M = \frac{8 \text{ mol}}{0.4 \text{ L}} = \boxed{20 \text{ M}}$$

c. 30 g NaCl in 1 L solution

$$30 \text{ g} \div 58.44 \frac{\text{g}}{\text{mol}} = 0.51 \text{ mol}$$

$$M = \frac{0.51 \text{ mol}}{1 \text{ L}} = \boxed{0.51 \text{ M}}$$





# LIVING BY CHEMISTRY

- 72) What portion of 2.0 L of 0.50M blue dye solution contains the same number of moles as 2.0 L of a 0.25M blue dye solution?

$$2.0L \text{ of } 5M = ? \text{ mol}$$

VS.

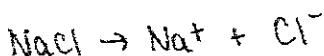
$$2.0L \text{ of } 0.25M = ? \text{ mol}$$

$$2L \times 5M = 10 \text{ mol}$$

← 1/20 of 10 mol is .5 mol

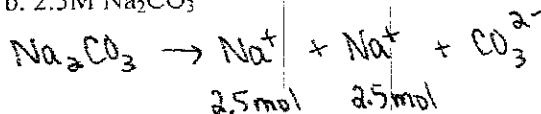
$$2L \times 0.25M = 0.5 \text{ mol}$$

- 73) How many moles of  $\text{Na}^+$  are in:  
a. 0.50M NaCl



0.5 mol

- b. 2.5M  $\text{Na}_2\text{CO}_3$



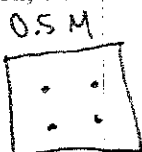
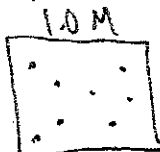
2.5 mol

2.5 mol

5 mol

- 74) Draw a picture of a 1.0M solution, 0.5M solution, and 2.0M solution.

ex



- 75) How many liters of solution would contain 0.25 mol NaCl in a 2.5M solution?

$$\text{liters} = \frac{\text{mol}}{\text{molarity}} = \frac{0.25 \text{ mol}}{2.5 \text{ mol/L}} = 0.1 \text{ liters}$$

- 76) How many moles of HCl are in 250 mL of a 1.5M solution?

$$\text{moles} = \text{liters} \times \text{molarity}$$

$$(0.250 \text{ L})(1.5 \text{ M}) = 0.375 \text{ moles}$$

- 77) Describe the procedure and show the calculations for creating 500 mL of a 0.4M Kool-Aid solution. (The molar mass of KoolAid is 342 g/mol)

$$1) \text{ moles} = (0.5L)(0.4 \text{ M}) = 0.2 \text{ mol}$$

$$2) 0.2 \text{ mol} \times 342 \frac{\text{g}}{\text{mol}} = 68.4 \text{ g}$$

3) Add 68.4 g Kool-Aid to container. Fill with water up to 500 mL

## Unit 4, Section IV

- 78) What are some general properties of acids and bases?

Acids	Bases
* $\text{H}^+$	* $\text{OH}^-$
* sour taste	* bitter
* $\text{pH} < 7$	* slippery

- 79) What is the pH scale? Where do acids, bases, and neutral substances fall on it?

Describes acidity/basicity of substance



- 80) Give two examples of an indicator. What is the purpose of using an indicator?

Litmus paper

uses color to indicate pH or classify as

Cabbage juice

identifying acids or bases

- 81) What is the Arrhenius definition of an acid and a base? Provide an example of each.

Acid: Forms  $\text{H}^+$  in solution (ex. HCl)

Base: Forms  $\text{OH}^-$  in solution (ex. NaOH)

# LIVING BY CHEMISTRY

82) What is the Bronsted-Lowry definition of an acid and a base? Provide an example of each.

Acid:  $H^+$  donor ( $H^+$  also called a proton) ex.  $H_2SO_4$

Base:  $H^+$  acceptor ex.  $NH_3$  (receives  $H^+$  from  $H_2O$ , leaving  $OH^-$ )

83) Are the following examples acids or bases?

a. slippery feeling B

b. NaOH B

c. hydrochloric acid A

d. drain cleaner B

e. pH=2 A

f. distilled water Neutral

g.  $H_2CO_3$  A

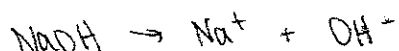
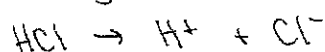
h.  $Ca(OH)_2$  B

i. barium hydroxide B

j. pH=11 B

84) What is "dissociation"? How does HCl dissociate in water? How does NaOH dissociate in water?

Breaking apart into ions



85) How are weak acids different from strong acids?

Weak only dissociate partially whereas strong dissociate completely

86) What does it mean that the pH scale is a logarithmic scale?

Base 10; Each difference in one digit on pH scale is a 10x difference in strength

87) Which is more acidic: pH=2 or pH=4? How much more acidic is the stronger acid?

pH=2 is 100x more acidic ( $10^2 = 100x$ )

88) Determine the following pH values:

a.  $[H^+] = 1.0 \times 10^{-4}$  pH = 4

b.  $[H^+] = 1.0 \times 10^{-8}$  pH = 8

c. 2.5M HCl

$$\downarrow$$

$$[H^+] = 2.5 = -0.4$$

d. pOH=8 pH = 6

e.  $[OH^-] = 1.0 \times 10^{-9}$  pOH = 9

pH = 5

89) How much water do you need to add to 50 mL of a solution to change the pH from 3 to 5.

$$pH = 3 : [H^+] = 1 \times 10^{-3}$$

$$pH = 5 : [H^+] = 1 \times 10^{-5}$$

$$\Rightarrow \text{dilution} = \frac{1 \times 10^{-3}}{1 \times 10^{-5}} = 100 \Rightarrow \text{Final } V = 100 \times 50 \text{ mL} = 5000 \text{ mL}$$

90) a) How many moles of  $H^+$  are in 0.75 L of 0.25M HCl?

$$\text{moles} = \text{Molarity} \times \text{liters} = (0.25)(0.75) = 0.1875 \text{ mol}$$

$$5000 \text{ mL} - 50 \text{ mL} = 4950 \text{ mL}$$

b) If you add 15 mL of water, what is the new concentration?

$$\text{Molarity} = \frac{\text{mol}}{L} = \frac{0.1875 \text{ mol}}{(0.75 \text{ L} + 0.015 \text{ L})} = \frac{0.1875 \text{ mol}}{0.765 \text{ L}} = 0.245 \text{ M}$$

